



General

Guideline Title

Best evidence statement (BEST). Confirmation of nasogastric/orogastric tube (NGT/OGT) placement.

Bibliographic Source(s)

Cincinnati Children's Hospital Medical Center. Best evidence statement (BEST). Confirmation of nasogastric/orogastric tube (NGT/OGT) placement. Cincinnati (OH): Cincinnati Children's Hospital Medical Center; 2011 Aug 22. 9 p. [25 references]

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: Cincinnati Children's Hospital Medical Center. Best evidence statement (BEST). Confirmation of nasogastric tube placement in pediatric patients. Cincinnati (OH): Cincinnati Children's Hospital Medical Center; 2009 Apr 27. 11 p. [20 references]

Recommendations

Major Recommendations

The strength of the recommendation (strongly recommended, recommended, or no recommendation) and the quality of the evidence (1-5) are defined at the end of the "Major Recommendations" field.

1. It is recommended that radiologic verification be used to determine nasogastric/orogastric tube (NGT/OGT) placement in pediatric patients who are at high risk of aspiration or when non-radiologic methods are not feasible, or results are unclear.

Note: Pediatric patients at risk for incorrect tube placement include those who have neurologic impairment and other conditions which may increase the difficulty of safe, effective tube placement and include patients who are obtunded, sedated, unconscious, critically ill and those with reduced gag reflex or static encephalopathy (Metheny et al., "Techniques," 1994 [3a]; Phang et al., 2004 [3b]; Ellett & Beckstrand, 1999 [4b]).

Note: Radiologic verification is considered the gold standard but may contribute to higher costs, decreased convenience, and increased radiation exposure (Metheny et al., "Techniques," 1994 [3a]; Metheny & Stewart, 2002 [3a]; Nyqvist, Sorell, & Ewald, 2005 [4a]; Peter & Gill, 2009 [4a]; Ellett & Beckstrand, 1999 [4b]; Westhus, 2004 [4b]).

2. It is recommended that non-radiological verification methods be used to confirm placement of NGT/OGT in pediatric patients who are not considered at high risk for aspiration as outlined above, using the following method:

Aspirate acidity (pH) testing: Use aspirate pH ≤ 5 to confirm gastric placement (Ellett et al., 2005 [3a]; Metheny et al., "Indicators," 1999 [4a]; Metheny & Stewart, 2002 [3a]; Metheny et al., "pH," 1999 [4a]; Metheny et al., 1993 [3a]) (see Table 1 in the original guideline

document).

Note: Gastric aspirate pH mean is statistically lower (higher acidity) compared to intestinal aspirate mean pH (Metheny et al., "pH," 1999 [4a]).

Note: Mean pH of respiratory aspirate from the tracheobroncheal tree or plural space is statistically higher than gastric aspirate pH (Metheny et al., "pH," 1999 [4a]).

Note: pH testing can be accurately done with pH paper or pH meter (Ellett et al., 2005 [3a]; Metheny et al., "pH," 1994 [3a]; Westhus, 2004 [4b]).

Note: Mean values for gastric aspirate are not significantly different when patients are fed or fasting (Metheny & Stewart, 2002 [3a]; Metheny et al., "pH and concentration," 1999 [4a]).

Note: Mean values for aspirate are not significantly different when patients are on or off acid suppression medications (Ellett et al., 2005 [3a]; Metheny et al., "pH," 1994 [3a]).

Note: Auscultation has been shown to have poor reliability and is not recommended as a sole verification method. (Ellett & Beckstrand, 1999 [4b]; Metheny & Stewart, 2002 [3a]; Metheny et al., 1990 [4a]; Neumann et al., 1995 [3b]).

Note: Visual inspection of aspirate has not been shown to be a reliable sole method of verification; however, it may have some use when done in conjunction with pH testing (Garpure et al., 2000 [4a]; Metheny & Stewart, 2002 [3a]; Metheny et al., "Indicators," 1999 [4a]; Metheny et al., "Techniques," 1994 [3a]; Metheny et al., "Visual," 1994 [4a]; Phang et al., 2004 [3b]; Westhus, 2004 [4b]).

Note: Aspirate testing of enzyme levels for bilirubin, pepsin, and trypsin also provide an alternate method of verification, but it is limited to laboratory assessment (Ellett et al., 2005 [3a]; Garpure et al., 2000 [4a]; Metheny & Stewart, 2002 [3a]; Metheny et al., "pH and concentration," 1999 [4a]; Westhus, 2004 [4b]).

Note: While carbon dioxide (CO₂) monitoring provides an alternate method of verification, it requires a capnograph monitor to determine incorrect tube placement (Ellett et al., 2005 [3a]).

3. It is recommended that NGT/OGT length be predicted as follows:

For children >2 weeks, age-related height-based (ARHB) methods are more accurate than other morphological measures such as nose-ear-xiphoid (NEX) or nose-ear-mid-xiphoid-umbilicus (NEMU) in predicting tube length and can be calculated using prediction equation tables (see Table below: Age-related height-based equations for nasogastric tube [NGT] length predictions) (Beckstrand, Ellett, & McDaniel, 2007 [4a]; Ellett et al., 1992 [4b]; Klasner, Luke, & Scalzo, 2002 [2b]; Putnam & Orenstein, 1991 [4a]; Strobel et al., 1979 [4b]).

For neonates less than 2 weeks of age, patients with short stature, or if unable to obtain an accurate height, use morphological measurements such as NEX or NEMU (Beckstrand, Ellett, & McDaniel, 2007 [4a]).

Note: Measurement using the NEMU method for tube length prediction versus the NEX method is slightly more reliable for tube length prediction (Beckstrand, Ellett, & McDaniel, 2007 [4a]; Gallaher et al., 1993 [3a]; Weibley et al., 1987 [4a]).

Note: Short stature is defined as a standing height more than 2 standard deviations (SDs) below the mean (or below the 2.5 percentile) for sex (Cohen et al., 2008 [5]).

Note: Mark tube length at the nare for NGT, or corner of the mouth for OGT with indelible permanent marker and document amount of tube remaining (external visible length) (EVL) outside the patient in the patient record (Weibley et al., 1987 [4a]).

Table: Age-related Height-based (ARHB) Prediction Equations for the Internal Distance to the Body of the Stomach for Use in Clinical Practice, by Route of Insertion and Age in Children

Route	Age Group (months)	Predicted Internal Distance to the Body of the Stomach
Oral	Age ≤28	9.1 cm + 0.183 (height cm) + 6 cm + 1.5 cm = 16.6 + 0.183 (height cm)
	28 < age ≤ 100	9.1 cm + 0.183 (height cm) + 8 cm + 3 cm = 20.1 + 0.183 (height cm)
	100 < age ≤ 121	4.5 cm + 0.218 (height cm) + 7.5 cm + 5 cm = 17 + 0.218 (height cm)

Route	Age Group (months)	Predicted Internal Distance to the Body of the Stomach
Nasal	Age >121	$4.5 \text{ cm} + 0.218 (\text{height cm}) + 9 \text{ cm} + 5 \text{ cm} = 18.5 + 0.218 (\text{height cm})$
	Age <28	$10.1 \text{ cm} + 0.197 (\text{height cm}) + 6 \text{ cm} + 1.5 \text{ cm} = 17.6 + 0.197 (\text{height cm})$
	$28 < \text{age} < 100$	$10.1 \text{ cm} + 0.197 (\text{height cm}) + 8 \text{ cm} + 3 \text{ cm} = 21.1 + 0.197 (\text{height cm})$
	$100 < \text{age} < 121$	$4.5 \text{ cm} + (2.7) + 0.218 (\text{height cm}) + 6.5 \text{ cm} + 5 \text{ cm} = 18.7 + 0.218 (\text{height cm})$
	Age >121	$4.5 \text{ cm} + (2.7) + 0.218 (\text{height cm}) + 9 \text{ cm} + 5 \text{ cm} = 21.2 + 0.218 (\text{height cm})$

Note: the distance measured is to the bottom of the distal pore on the tube Beckstrand, (2007) [4a] Used with permission.

See Figure 1 in the original guideline document for Algorithm: Confirmation of NGT/OGT Placement.

Definitions:

Table of Evidence Levels

Quality Level	Definition
1a [†] or 1b [†]	Systematic review, meta-analysis, or meta-synthesis of multiple studies
2a or 2b	Best study design for domain
3a or 3b	Fair study design for domain
4a or 4b	Weak study design for domain
5	Other: general review, expert opinion, case report, consensus report, or guideline

[†]a = good quality study; b = lesser quality study

Table of Recommendation Strength

Strength	Definition
"Strongly recommended"	There is consensus that benefits clearly outweigh risks and burdens (or vice versa for negative recommendations).
"Recommended"	There is consensus that benefits are closely balanced with risks and burdens.
No recommendation made	There is a lack of consensus to direct development of a recommendation.

Dimensions: In determining the strength of a recommendation, the development group makes a considered judgment in a consensus process that incorporates critically appraised evidence, clinical experience, and other dimensions as listed below.

1. Grade of the body of evidence
2. Safety/harm
3. Health benefit to the patients (direct benefit)
4. Burden to patient of adherence to recommendation (cost, hassle, discomfort, pain, motivation, ability to adhere, time)
5. Cost-effectiveness to healthcare system (balance of cost/savings of resources, staff time, and supplies based on published studies or onsite analysis)
6. Directness (the extent to which the body of evidence directly answers the clinical question [population/problem, intervention, comparison, outcome])
7. Impact on morbidity/mortality or quality of life

Clinical Algorithm(s)

A clinical algorithm for the confirmation of nasogastric or orogastric tube (NGT/ORT) placement is provided in the original guideline document.

Scope

Disease/Condition(s)

Conditions in pediatric and adolescent patients that require a nasogastric/orogastric tube (NGT/OGT)

Guideline Category

Assessment of Therapeutic Effectiveness

Evaluation

Clinical Specialty

Critical Care

Pediatrics

Radiology

Intended Users

Advanced Practice Nurses

Nurses

Physician Assistants

Physicians

Guideline Objective(s)

- To evaluate, among pediatric patients who require nasogastric/orogastric tube (NGT/OGT) placement, if auscultation, acidity (pH), enzyme, visual inspection of aspirate, and carbon dioxide (CO₂) testing compared to radiological verification provides an accurate confirmation of tube placement.
- To evaluate, among pediatric patients who require NGT/OGT placement, if tube length predictions using age-related height-based (ARHB) methods compared to nose-ear-xiphoid (NEX) morphological measurements are more accurate in predicting tube length.

Target Population

Pediatric patients who require nasogastric/orogastric tube (NGT/OGT) placement for feeding or gastric decompression

Interventions and Practices Considered

1. Verification methods
 - Radiological verification
 - Aspirate pH

- Gastric auscultation (not recommended as the sole verification method)
- Visual inspection of aspirate in conjunction with aspirate pH
- Aspirate testing of enzyme levels for bilirubin, pepsin, and trypsin
- Carbon dioxide (CO₂) monitoring

2. Nasogastric tube length prediction:

- Age-related height-based methods
- Morphological measurements, including nose-ear-xiphoid (NEX) and nose-ear-mid-xiphoid-umbilicus (NEMU)

Major Outcomes Considered

- Incidence of misplaced nasogastric/orogastric tube (NGT/OGT) tubes
- Reliability of NGT/OGT placement verification methods
- Effect of feeding and medications on gastric aspirate testing
- Predictive success of methods to calculate NGT/OGT tube length
- Reduction in exposure of pediatric patients to x-rays
- Time to delivery of clinical care via NGT/OGT
- Patient/family satisfaction

Methodology

Methods Used to Collect/Select the Evidence

Hand-searches of Published Literature (Primary Sources)

Hand-searches of Published Literature (Secondary Sources)

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

OID Databases

- Medline, CINAHL, PubMed and the Cochrane Database for Systematic Reviews (CDSR)

OID Filters

- Publication Date: 1996 to present
- Limits: Humans and English language
- Study Type: Highest quality evidence

Search Terms and MeSH Terms

- Children, nasogastric tube, NG tube, aspirate, auscultation, radiology, morphological, age-related height based, accuracy, prediction, length.

Additional articles identified from reference lists and clinicians.

Number of Source Documents

Not stated

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Table of Evidence Levels

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5	Other: general review, expert opinion, case report, consensus report, or guideline

[†]a = good quality study; b = lesser quality study

Methods Used to Analyze the Evidence

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

Not stated

Methods Used to Formulate the Recommendations

Expert Consensus

Description of Methods Used to Formulate the Recommendations

Not stated

Rating Scheme for the Strength of the Recommendations

Table of Recommendation Strength

Strength	Definition
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No recommendation made	There is a lack of consensus to direct development of a recommendation.
Dimensions: In determining the strength of a recommendation, the development group makes a considered judgment in a consensus process that incorporates critically appraised evidence, clinical experience, and other dimensions as listed below.	
1. Grade of the body of evidence	

Strength	Definition
2. Safety/harm	
3. Health benefit to the patients (direct benefit)	
4. Burden to patient of adherence to recommendation (cost, hassle, discomfort, pain, motivation, ability to adhere, time)	
5. Cost-effectiveness to healthcare system (balance of cost/savings of resources, staff time, and supplies based on published studies or onsite analysis)	
6. Directness (the extent to which the body of evidence directly answers the clinical question [population/problem, intervention, comparison, outcome])	
7. Impact on morbidity/mortality or quality of life	

Cost Analysis

A formal cost analysis was not performed and published cost analyses were not reviewed.

Method of Guideline Validation

Peer Review

Description of Method of Guideline Validation

Reviewed against quality criteria by two independent reviewers.

Evidence Supporting the Recommendations

References Supporting the Recommendations

Beckstrand J, Cirgin Ellett ML, McDaniel A. Predicting internal distance to the stomach for positioning nasogastric and orogastric feeding tubes in children. *J Adv Nurs*. 2007 Aug;59(3):274-89. [PubMed](#)

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Nyqvist KH, Sorell A, Ewald U. Litmus tests for verification of feeding tube location in infants: evaluation of their clinical use. *J Clin Nurs.* 2005 Apr;14(4):486-95. [PubMed](#)

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Type of Evidence Supporting the Recommendations

The type of supporting evidence is identified and graded for each recommendation (see the "Major Recommendations" field).

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

- Appropriate placement of a nasogastric/orogastric tube (NGT/OGT) in pediatric patients using radiological or non-radiological methods
- Non-radiological NGT/OGT placement methods contribute to decreased radiation exposure for pediatric patients.
- Methods which can be performed at the bedside allow greater convenience for the patients, families and staff, and may contribute to decreased costs.

Potential Harms

- Side effects include improperly placed tube due to measurement or placement error.
- Risks of improperly placed tubes include aspiration, feeding into the wrong place, and irritation.

Qualifying Statements

Qualifying Statements

This Best Evidence Statement addresses only key points of care for the target population; it is not intended to be a comprehensive practice guideline. These recommendations result from review of literature and practices current at the time of their formulation. This Best Evidence Statement does not preclude using care modalities proven efficacious in studies published subsequent to the current revision of this document. This document is not intended to impose standards of care preventing selective variances from the recommendations to meet the specific and unique requirements of individual patients. Adherence to this Statement is voluntary. The clinician in light of the individual circumstances presented by the patient must make the ultimate judgment regarding the priority of any specific procedure.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Implementation Tools

Clinical Algorithm

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Staying Healthy

IOM Domain

Effectiveness

Safety

Identifying Information and Availability

Bibliographic Source(s)

Cincinnati Children's Hospital Medical Center. Best evidence statement (BEST). Confirmation of nasogastric/orogastric tube (NGT/OGT) placement. Cincinnati (OH): Cincinnati Children's Hospital Medical Center; 2011 Aug 22. 9 p. [25 references]

Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

2009 Apr 27 (revised 2011 Aug 22)

Guideline Developer(s)

Cincinnati Children's Hospital Medical Center - Hospital/Medical Center

Source(s) of Funding

Cincinnati Children's Hospital Medical Center

Guideline Committee

Guideline Development Group

Composition of Group That Authored the Guideline

Revision Group/Team Leader: Sherri Sievers, MSN, RN, CNP, Department of Anesthesia

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Financial Disclosures/Conflicts of Interest

Not stated

Guideline Status

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Guideline Availability

Electronic copies: Available from the [Cincinnati Children's Hospital Medical Center Web site](#) .

Print copies: For information regarding the full-text guideline, print copies, or evidence-based practice support services contact the Cincinnati Children's Hospital Medical Center Health James M. Anderson Center for Health Systems Excellence at EBDMInfo@cchmc.org.

Availability of Companion Documents

The following are available:

- Judging the strength of a recommendation. Cincinnati (OH): Cincinnati Children's Hospital Medical Center; 2008 Jan. 1 p. Available from the [Cincinnati Children's Hospital Medical Center Web site](#) .
- Grading a body of evidence to answer a clinical question. Cincinnati (OH): Cincinnati Children's Hospital Medical Center; 1 p. Available from the [Cincinnati Children's Hospital Medical Center Web site](#) .
- Table of evidence levels. Cincinnati (OH): Cincinnati Children's Hospital Medical Center; 2008 Feb 29. 1 p. Available from the [Cincinnati Children's Hospital Medical Center Web site](#) .

Print copies: For information regarding the full-text guideline, print copies, or evidence-based practice support services contact the Cincinnati Children's Hospital Medical Center Health James M. Anderson Center for Health Systems Excellence at EBDMInfo@cchmc.org.

Patient Resources

None available

NGC Status

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